Space Weather Technical Forecast

Issued on Tuesday, 11 June 2024 at 12:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

We are aware of a possible disruption to data flow from the Space Weather Prediction Centre on Tuesday the 11th June (1500-2100UTC). As a result, our Alerts and Warnings service may experience delays or contain incomplete data.

Space Weather Forecast Headline: M-flares (R1-R2 radio blackouts) initially likely, slight chance of X-flares (R3 blackout), risk then declining. Chance of minor solar radiation storm (S1-S2) initially, risk declining through the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with an M9.5 flare peaking at 10/1840 UTC from AR3697 near the southwest limb. There are currently eight sunspot regions on the visible disc. The most active region is AR3697 which has now rotated off the southwest limb and is no longer clearly visible. It will continue to contribute to the flare risk for another 24 hours or so until it is well away from the southwest limb. AR3709 in the southeast is now the largest region on the disc. It consists of a large leader spot with smaller spots around it. The remaining sunspot regions are mostly simple and stable. Some looping observed in SDO imagery suggests a new region to rotate onto the southeast limb in the next 24 hours.

No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, were at background levels initially, before the arrival of a CME at 10/1536 UTC (which left the Sun on 08 June), with speeds reaching elevated levels, peaking around 500-550 km/s. Solar winds have since recently shown a decline in speeds, currently at around 410 km/s. Density was below average initially, before increasing to above average, peaking at 17ppcc at 10/1646 UTC due to the CME arrival. The IMF (Interplanetary Magnetic Field), Bt, was weak at 6nT or below initially, but increased to reach a peak of 16nT with the arrival of the CME. This has since reduced back to weak levels. The north-south component, Bz, was initially weak, but peaked at -11nT at 10/1650 UTC during the CME arrival. It has also dropped back to weak levels, with only brief negative intervals. The phi angle was initially positive (away from the Sun), but has since varied between positive and negative. Geomagnetic activity was Quiet (Kp1) initially, increasing to Unsettled to Active (Kp3-4) from 10/1500-11/0600 UTC due to CME influence.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 continued to ease below the S1/Minor radiation storm level but remained above background levels, with a recent slight increase noticed, likely as a result of flaring from AR3697 on 10 Jun.

High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels, with the associated 24-hour fluence well below Active. Observed fluence at 11/0000 UTC was 1.15e6 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: M-flares are initially considered to be likely with a slight chance of further X-flares, mainly from AR3697, which has rotated off the disc, but could still contribute to the flare risk. The risk reduces through Day 1 (11 June) as AR3697 continues to rotate further away from the west limb.

Solar Wind / Geomagnetic Activity: Lingering effects from the CME arrival on 10 Jun (which left the Sun on 08 June) are possible through Day 1 (11 Jun). Solar winds have recently decreased from elevated levels, and are expected to ease further to background through Day 1. A further slight enhancement in solar winds is possible from the small CH44/- in south centre disc later on Day 3 or early Day 4 (13-14 June), but any geomagnetic response is expected to be limited,

Geomagnetic activity is likely to be Quiet to Unsettled (Kp1-3) at first, with a chance for Active (Kp4) intervals early on Day 1 due to any lingering influence of the 10 Jun CME arrival. Mostly Quiet conditions are likely from Day 2 (12 Jun) onward, with a slight chance of Unsettled to Active intervals later on Day 3 and Day 4 (13-14 Jun) due to any weak high speed stream influence from CH44/-.

Energetic Particles / Solar Radiation: High energy proton flux is now below S1/Minor radiation storm levels after the recent S3/Strong enhancement. A reducing risk of further S1 or S2 radiation storms as AR3697 continues to rotate further away from the southwest limb in the next 24 hours.

High energy electron flux is forecast to persist at predominantly background levels, and the associated 24-hour fluence forecast should remain below the Active threshold.

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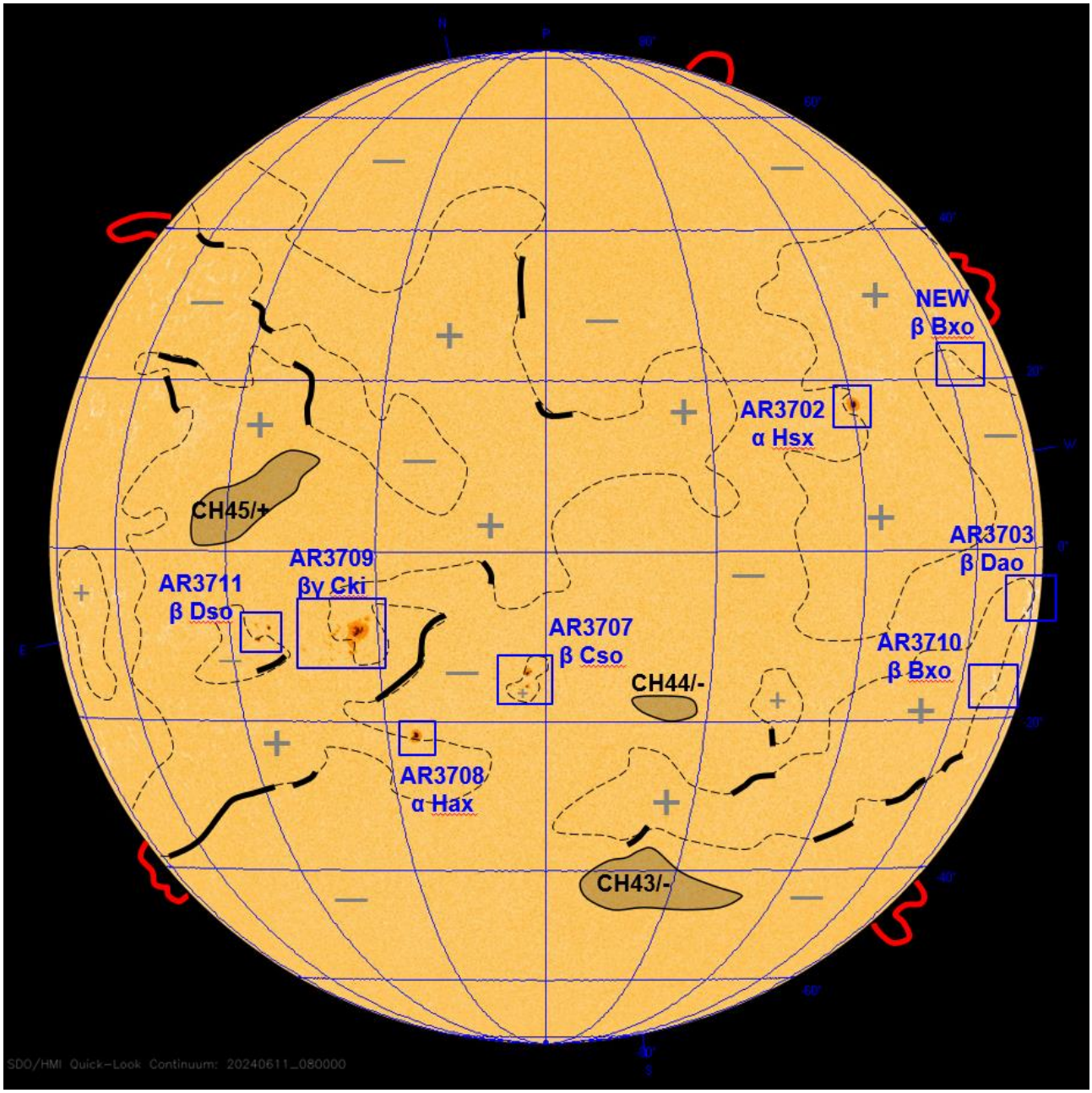
Figure 1. Solar Analysis Valid 11/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The M9.7 flare from AR3697 at 08/0149UTC in the southwestern disc generated a CME which was observed arriving at L1 at 10/1645 UTC. Geomagnetic activity however was fairly muted at Earth, with the CME likely just giving Earth a glancing blow.

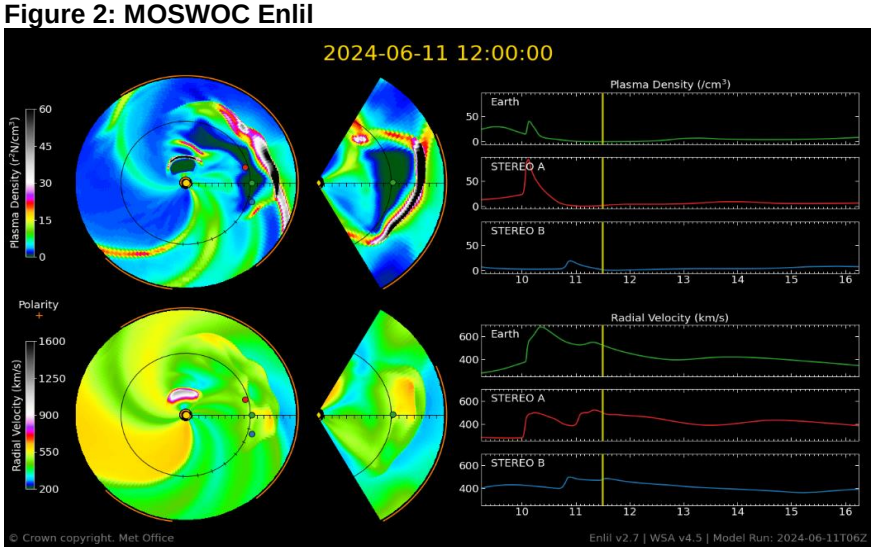
No Earth-directed CMEs have been seen in available coronagraph imagery in the past 24 hours.

Solar wind speeds are currently falling from elevated levels observed during the CME arrival mentioned above, currently around 400 km/s. These are expected to ease further to background levels through Day 1 (11 June) as the CME influence continues to wane. A slight further enhancement is possible from the small coronal hole CH44/-, currently situated in the south centre disc, later on Day 3 into Day 4 (13-14 Jun). This is expected to give a limited geomagnetic response however, due to its size and no notable increase in wind speeds on the previous rotation.

Overall, geomagnetic activity is likely to be Quiet to Unsettled (Kp1-3) initially, with a slight chance of Active intervals early on Day 1 (11 Jun) due to any lingering influence of the 10 Jun CME arrival. Mostly Quiet conditions are then likely from Day 2 (12 Jun) onward, with a slight chance of Unsettled to Active intervals later on Day 3 and Day 4 (13-14 Jun) due to any weak high speed stream influence from CH44/-.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil



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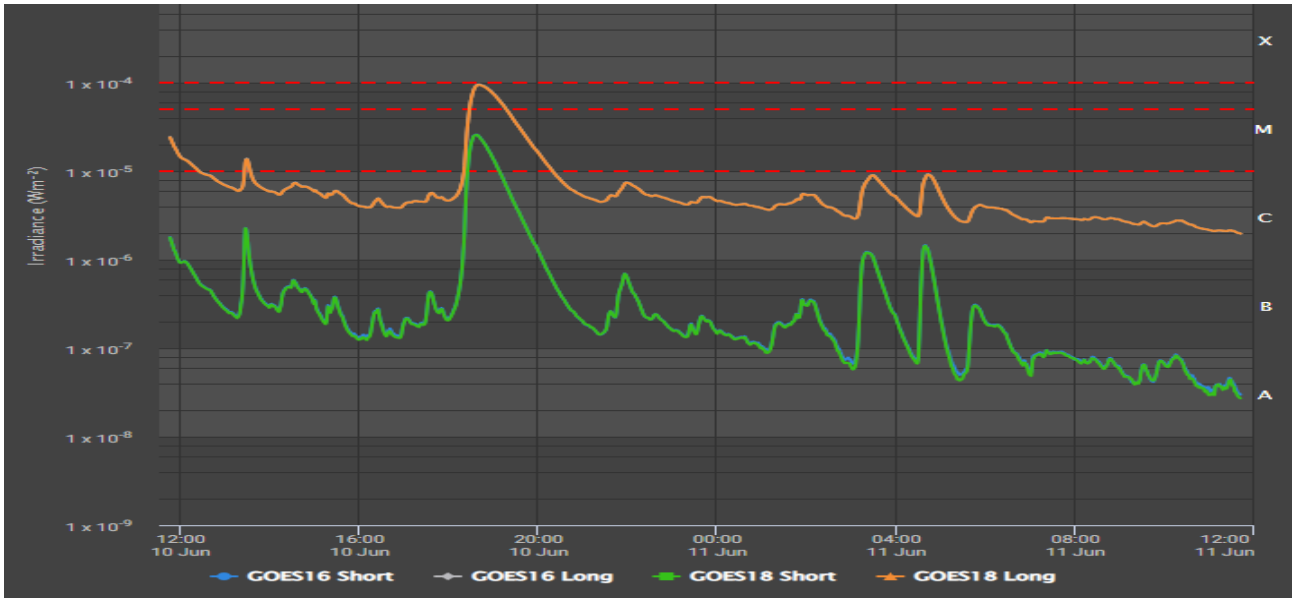
Radio Blackouts - X-Ray Flares:
Solar activity is Moderate with an M9.5 flare peaking at 10/1840 UTC from AR3697 over the southwest limb.

There are currently eight sunspot regions on the visible disc, with one unnumbered region in the northeast. The most active region is AR3697, but this has rotated off the southwest limb and is no longer visible. It will continue to contribute to the flare risk for another 12 hours or so until it is well away from the southwest limb. AR3709 in the southeast is now the largest region on the disc. It consists of a large leader spot with smaller spots around it. The remaining regions are mostly simple and stable at the present time. Some magnetic looping observed in SDO imagery suggests a new region to rotate onto the southeast limb in the next 24 hours.

M-flares are initially considered to be likely with a slight chance of further X-flares, mainly from AR3697, which has rotated just beyond the southwest limb, so it's still in a good location. The risk will reduce after Day 1 (11 June) as AR3697 rotates away further away from the southwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	40	30	30
Very Active	R3 to R5 X Class	No	15	5	1	1

Figure 3: GOES-16 & -18 X-ray flux



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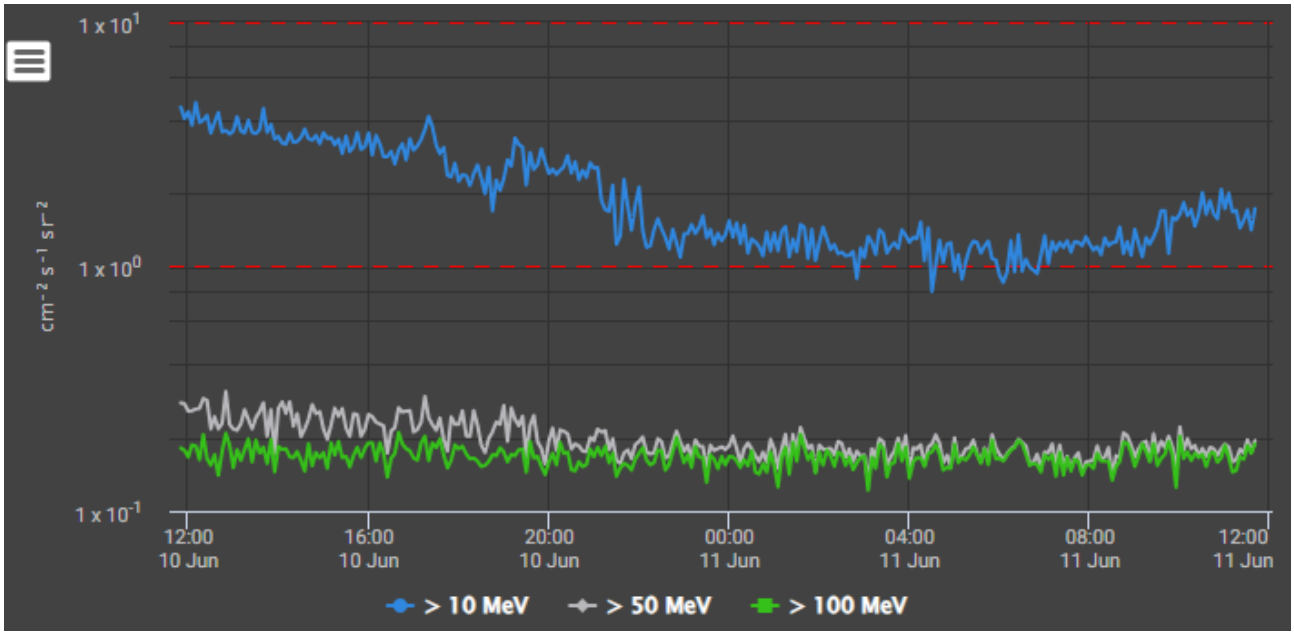
Solar Radiation Storms - (High Energy Protons):
AR3697 is currently in a good position to deliver further S-scale enhancements, with an S3 Solar storm observed on 08 June. Proton flux levels have since dropped below S1 levels, but continued flaring from this region means that there is a chance for proton flux levels to once again reach above S1-S2 during the next 24 hours or so. The risk from this region then reduces once it rotates further away from the west limb, during Days 2-3 (12-13 June).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	50	20	5	1
Very Active	**≥ S3 ***	No	10	5	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: GOES-18 Proton flux



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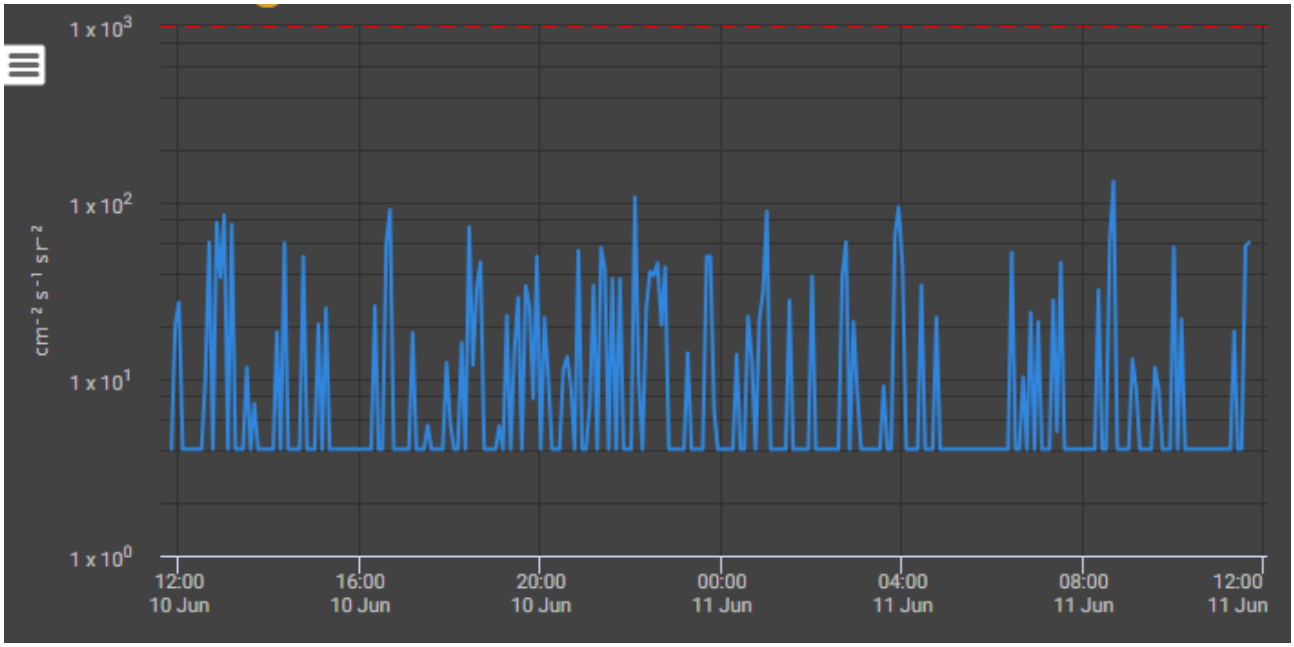
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux is likely to persist at background levels for much of this period.

MOSWOC REFM output has been forecasting fluence above the Active (1e8 integrated pfu) level to start this period, but this looks erroneous, with fluence expected to remain below Active throughout.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 Electron flux



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